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SOVIET GERMANIUM DIODES

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Instruments whose operation is based on the unidirectional conductivity of some semiconductors are finding ever-increasing application in modern radio-engineering equipment. The chief advantages of such instruments are their small dimensions, low weight, and low power drain.

Germanium is a typical semiconductor with unidirectional conductivity. The ability of germanium in contact with a metal to withstand high currents in one direction and high voltages in the other makes it suitable for use in the production of high-voltage diodes (See Figure 1 [appended]).

The main element in such a diode is the germanium crystal. Rectification occurs at the contact of germanium with the metal point; the contact surface is measured in microns. The internal structure and basic dimensions of the type DGTs diode is shown in Figure 2. These diodes are simple to produce, reliable in operation, are relatively insensitive to mechanical effects, and retain their properties during prolonged storage. The leads of the diode can be used to solder it directly into the circuit.

The volt-ampere characteristic of the germanium diode (See Figure 3) is nonlinear on both sides of the ordinate. In the forward direction (direction of high conductivity), the dependency between current and voltage is almost square-law at voltages up to 1 v. In the reverse direction, the current through the diode is very small even at high voltages.

The basic electrical parameters describing the operation of germanium diodes are the maximum inverse voltage, the minimum forward and maximum inverse currents, and the maximum continuous operation rectified current.

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Like other semiconducting rectifiers, high-voltage germanium diodes are sensitive to changes of ambient temperature. As a rule, the forward and inverse currents increase with increasing ambient temperature and decrease with decreasing ambient temperature. For example, at a temperature of + 70° C, the forward current is almost doubled, while the inverse current is approximately tripled.

The technical specifications established for the basic electrical parameters of various types of diodes produced by Soviet industry are given in the following table (for ambient temperatures of 20 ± 5° C).

Type	Max Inverse Working Voltage (v)	Min Inverse Breakdown Voltage (v)	Min Forward Current (ma) at + 1v	Max Inverse Current (ma) for a Working Voltage of -25	-50	-75	-100	Max Continuous Rectified Current (ma)
DG-Ts1	50	--	2.5	--	1.0	--	--	.25
DG-Ts2	50	75	4.0	--	0.5	--	--	.25
DG-Ts3	50	75	2.5	--	0.1	--	--	.25
DG-Ts4	75	100	2.5	--	--	0.8	--	.25
DG-Ts5	75	100	1.0	--	--	0.25	--	.25
DG-Ts6	100	125	2.5	--	--	--	0.8	.25
DG-Ts7	100	125	1.0	--	--	--	0.25	.25
DG-Ts8	30	50	10.0	0.5	--	--	--	.50

The maximum permissible diode current is attained when a voltage of 3-5 v is applied to the diode in the forward direction.

The dependency of average rectified current on frequency for a voltage of 2 v and various load resistances is illustrated by the curves in Figure 4. The curves were taken only for frequencies above 1 Mc because there is no appreciable reduction in rectification efficiency with increasing frequency at frequencies below 1 Mc. The decrease in rectification factor with increasing frequency is explained by the increasing volume resistance of the semiconductor and thus higher losses in the diode.

When it is necessary to increase the current in a circuit, type DGTs diodes can be connected in parallel. However, only those diodes which give identical rectified currents at a single voltage when connected in the circuit of Figure 5 can be connected in parallel.

If type DGTs diodes are connected in series, it is necessary that their volt-ampere characteristics have approximately the same inverse loops so that the voltage drop on each diode in operation will not exceed the norms established for the particular diode type.

To protect diodes against overloads in rectifier circuits, resistors which limit the current in the forward direction are ordinarily connected in series with the diodes. The life of type DGTs germanium diodes is at least 2,000 hours under continuous operation.

Germanium diodes can be used extensively in radio and measuring equipment. The small capacitance of germanium diodes in comparison with other types (vacuum, copper-oxide, and selenium) and their economy (obtained because of the absence of a filament) make them very effective for many applications.

Germanium diodes of the various types can be recommended for use in the following circuits:

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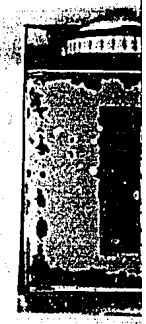

DG-Ts1 and DG-Ts2 -- measuring equipment, video detector, avc circuits, frequency detection circuits, second detector of superheterodyne receivers.

DG-Ts3 -- reinsertion of the dc component in television receivers, amplitude limiter, etc.

DG-Ts4 -- second detector of a superheterodyne receiver, avc circuits.

DG-Ts5 -- reinsertion of the dc component in television receivers, amplitude limiter.

DG-Ts6 -- rectifier.

DG-Ts7 -- rectifier, amplitude limiter, reinsertion of the dc component in television receivers.

DG-Ts8 -- measuring circuits, level indicators, video detector.

/Figures follow./

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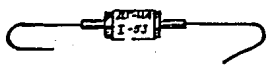

Figure 1. Exterior View of a Germanium Diode

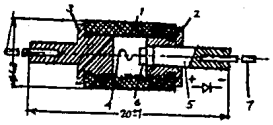

Figure 2. Construction and Dimensions of a Germanium Diode: 1- Ceramic Sleeve; 2,3-Metal Flanges; 4- Tungsten Wire Point; 5- Crystal Holder; 6- Germanium Crystal; 7- Wire Leads

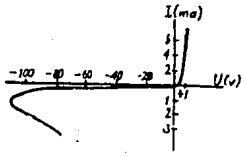

Figure 3. Volt-Ampere Characteristic of the Germanium Diode

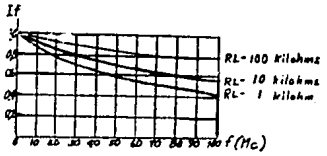

Figure 4. Curves Illustrating Dependency of Average Rectified Current on Frequency for Various Load Resistance; $R_L \times \frac{I_f}{I_0}$ is the Ratio of Rectified Current at a Given Frequency to the Rectified Current at 100 KC

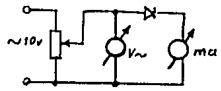

Figure 5. Circuit for Checking the Identity of Germanium Diodes

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